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# The Future of the JC3IEDM

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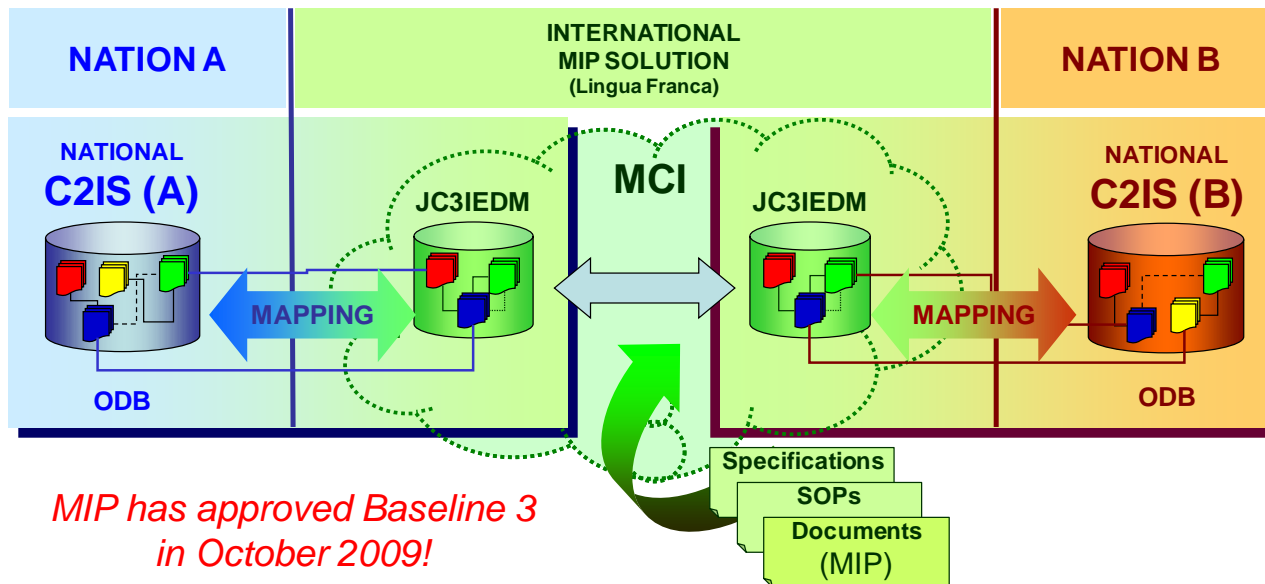
# Disclaimer

- Concepts and products are based on results from MIP working parties
  - Model-Driven Architecture & MDA Evaluation
  - Future Architecture
  - MIP System Architecture Design
- with contributions from many different people/institutions, e.g.
  - Institute for Defense Analyses (IDA)
  - Fraunhofer FKIE
  - ...
- *MIP has not yet taken any formal decision on the future of the JC3IEDM*

# Introduction

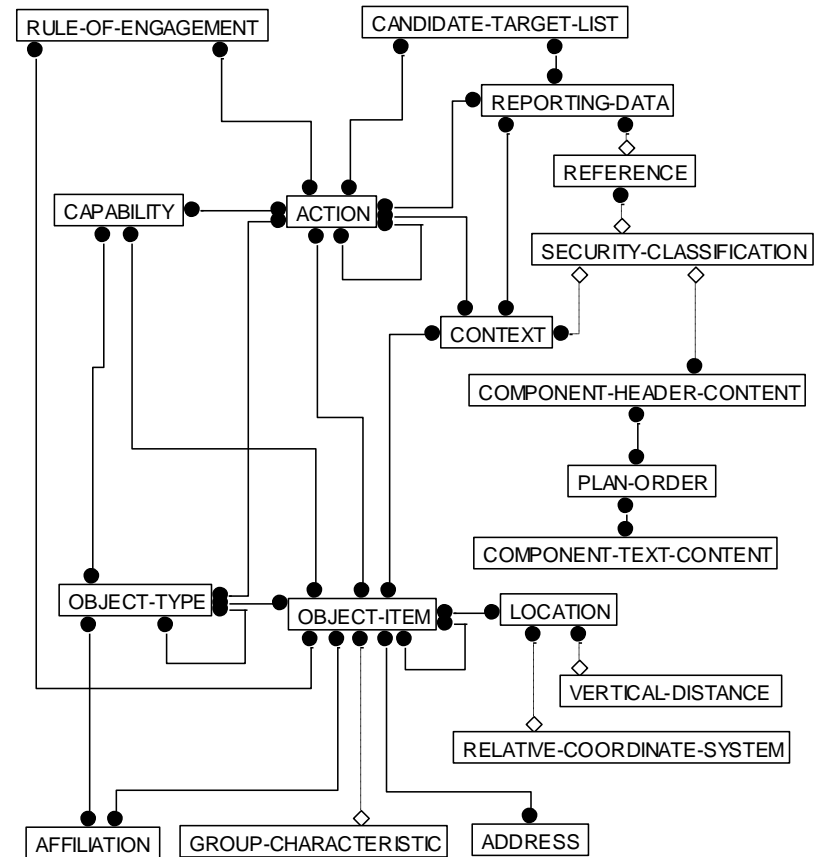
# Multilateral Interoperability Programme

“The aim of the Multilateral Interoperability Programme (MIP) is to achieve **international interoperability** of Command and Control Information Systems (C2IS) **at all levels** from corps to battalion, or lowest appropriate level, in order to **support multinational (including NATO), combined and joint operations** and the advancement of digitization in the international arena.”



# JC3IEDM

- Joint **C**onsultation, **C**ommand, and **C**ontrol Information **E**xchange **D**ata **M**odel
- NATO ratification as **STANAG 5525**
- Latest version: **JC3IEDM 3.0.2**
  - Plans & Orders, ATO, MMW, CBRN, ...
- Complex data model based on generic core concepts
- Entity relationship model
- Semantic definitions
  - Business Rules
  - Free-text documentation



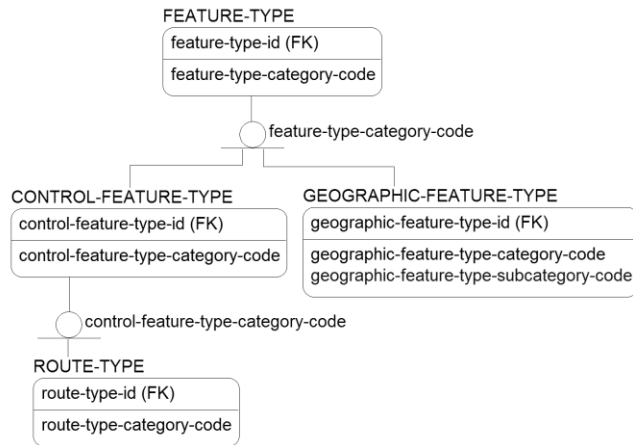
# Configuration Management of the JC3IEDM



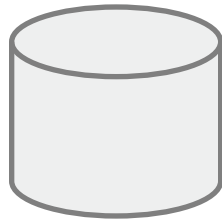
# Motivation

- JC3IEDM has been transformed from a small, generic hub into a comprehensive data model
  - LC2IEDM 2.2 (MIP Baseline 1): 149 entities
  - JC3IEDM 3.0.2 (MIP Baseline 3): 273 entities
- Growing size and complexity results in configuration management challenges
- Tracking and applying changes is laborious
- Entity-Relationship model in IDEF1X is platform-specific
  - Database concepts, e.g., key attributes, discriminator codes for sub-typing
  - Not perfectly suited to other application areas

# Consistency of Different Products



Logical/physical data model



Metadata (MIRD)

## G1.3.1 Rule for minefield-destruction-datetime

For the instances where the MINEFIELD is a MINEFIELD-LAND, then the minefield-destruction-datetime is filled only where minefield-land-persistence-code is "Remote activated destruction" or "Timed automatic destruction".

Business Rules

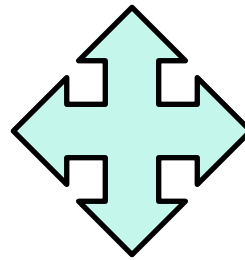


Table 42. Examples of EXECUTIVE-MILITARY-ORGANISATION-TYPE

(a) ORGANISATION-TYPE

organisati on-type-id	*-category-code	*-command- function- indicator-code	*-command-and- control-category- code	*-description- text
12345631	GOVERNMENT- ORGANISATION- TYPE	Yes	Headquarters	Executive military organisation
12345632	GOVERNMENT- ORGANISATION- TYPE	Yes	Headquarters	Executive military organisation
12345633	GOVERNMENT- ORGANISATION- TYPE	Yes	Headquarters	Executive military organisation

Note: \* = "organisation-type"

Examples

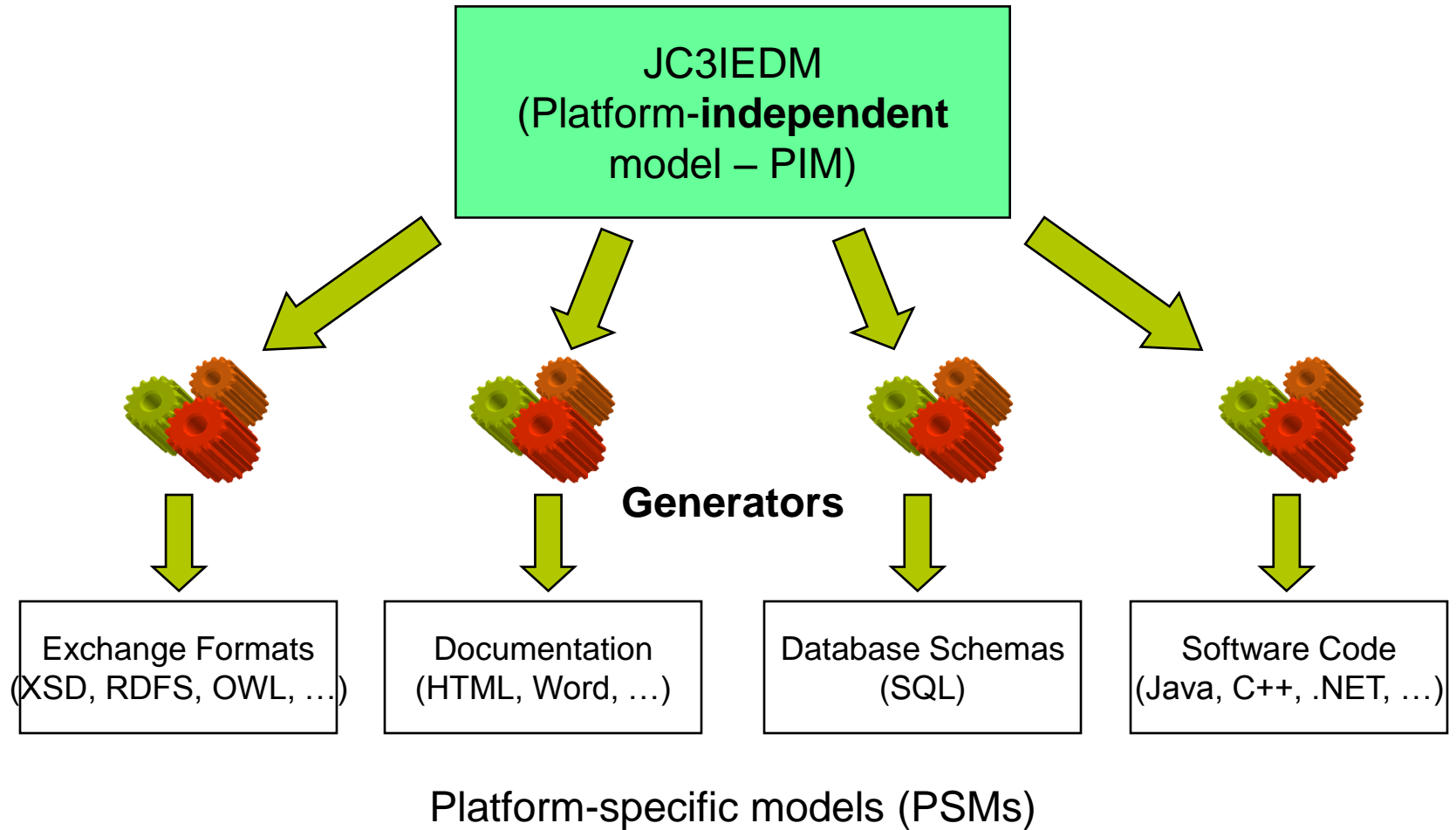
Domain Name	absolute-point-category-code				
Definition	The specific value that represents the class of ABSOLUTE-POINT with respect to the reference frame.				
Source	MP-NDAG				
Domain Values					
Value	Definition	Source	Physical Value	Identifier	
CARTESIAN-POINT	An ABSOLUTE-POINT that has its position specified in a three-dimensional Earth-centred Cartesian system.	MP-NDAG	CARTPT	1000001	
GEOGRAPHIC-POINT	An ABSOLUTE-POINT that has its position specified with respect to the surface of the World Geodetic System 1984 (WGS 84) ellipsoid.	MP-NDAG	GEOGPT	1000002	
Usage					
Entity		Attribute			Optional
ABSOLUTE-POINT		absolute-point-category-code			MA

Documentation

# Platform-Independent Model (PIM)

- Platform-independent model
  - Remove platform-specific elements
  - ➔ Improved comprehensiveness
  - Use generators to derive platform-specific models
- Unified Modeling Language (UML)
  - Great acceptance among software developers
  - Excellent tool support
  - Recommended by NATO Architecture Framework (NAF)

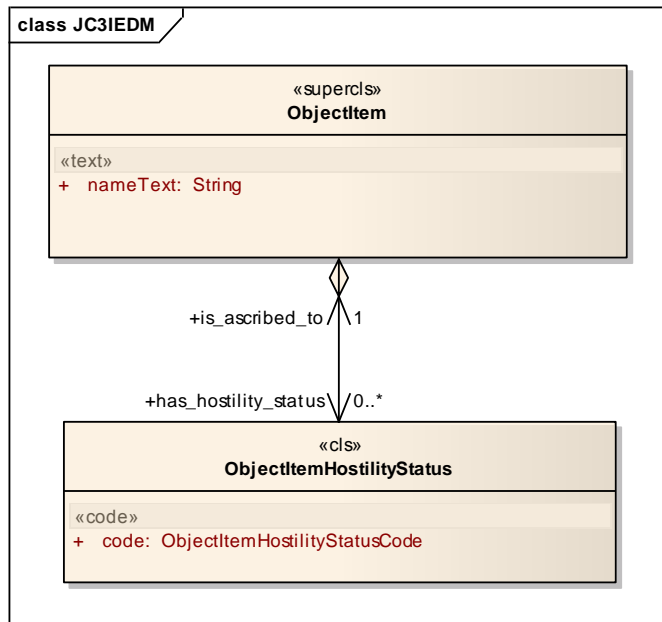
# Model-Driven Architecture (MDA)



# Formalization of Business Rules

## ■ Object Constraint Language (OCL)

- Rules can be validated against the JC3IEDM (statically)
- Rules can be evaluated by a MIP gateway/C2IS (dynamically at run-time)



**/\* G1.4.1 Part b \*/**

**context** ObjectItem


**inv:**

(self.ocllsKindOf(GeographicFeature) **or**  
self.ocllsKindOf(MeteorologicFeature))

**implies**

self.has\_hostility\_status->size() = 0

# Documentation with DocDB



**MIP MDA**  
Multilateral Interoperability Programme

Home | BL3 Documents | BLF Documents | Maintenance | Downloads | Wiki | Discussion | Links

Model Driven Architecture Tools and Techniques

**IDA**

JC3IEDM Documents

Home

Preface

**1. INTRODUCTION**

**2. OVERVIEW OF REQUIREMENTS**

**3. OVERVIEW OF THE DATA MODEL**

**4. OBJECT CLASSES (TYPES OF OBJECTS)**

**5. INDIVIDUALLY IDENTIFIABLE OBJECTS (ITEMS)**

**6. RELATIONSHIPS BETWEEN ITEMS AND TYPES**

**7. STATUS OF IDENTIFIABLE OBJECTS**

**8. NETWORKS AND ACCESS TO ITEMS THROUGH ADDRESSING**

**9. ObjectItem ASSOCIATIONS**

**10. CAPABILITIES OF OBJECTS AND TYPES**

**11. ESTABLISHMENT STRUCTURE**

**12. Location**

**13. ReportingData AND Reference**

**14. Context**

**15. BASIC Action STRUCTURE**

**16. EXTENSIONS TO Action STRUCTURE**

**17. SCHEMA FOR STANAG 2014-BASED Plans AND Orders**

**18. INTELLIGENCE**

## 7. STATUS OF IDENTIFIABLE OBJECTS

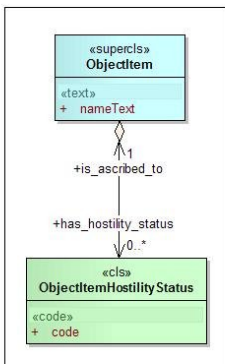
This chapter deals with a general requirement of specifying the status of items at a given time (past, present, or predicted). The main topics include:

- Classifying the hostility state of an **ObjectItem**,
- Assigning categories to **ObjectItems** to capture administrative, medical, physical, and procedural states or conditions.

[Section 7.1](#) provides the specifications for hostility status; [Section 7.2](#) is a general introduction to **ObjectItemStatus** and its subtypes; [Section 7.3](#) specifies the details for recording the status of all **ObjectItems** with the exception of **MedicalFacilityStatus** that is the subject of [Section 7.4](#). The chapter ends with [Section 7.5](#) that provides a cross-reference to the applicable business rules that are listed in [Annex G2](#).

### 7.1 ObjectItemHostilityStatus

7.1.1 Most objects of the battlefield can be characterised as friend or enemy. This information is not inherent to the specific object. The hostility status of an object is a classification that a specific organisation gives to this object. It means that a specific object may have different hostility status given by different organisations, and that the hostility status may vary with time. The known or perceived friendly or aggressive intentions of an object are recorded in the entity **ObjectItemHostilityStatus** whose structure of is illustrated in the figure below.



```

classDiagram
    class ObjectItem {
        <<supercls>>
        +text nameText
    }
    class ObjectItemHostilityStatus {
        <<cls>>
        +code code
    }
    ObjectItem "1" --> "0..*" ObjectItemHostilityStatus : is_ascribed_to
    ObjectItem --> ObjectItemHostilityStatus : has_hostility_status
        
```

**Figure 64. ObjectItemHostilityStatus**

7.1.2 **ObjectItemHostilityStatus** is defined as “A record of the perceived hostility classification of a specific **ObjectItem**.” Its attributes are:

- objectItemId**—The unique value, or set of characters, assigned to represent a specific **ObjectItem** and to distinguish it from all other **ObjectItems**. It is a

**JC3IEDM**  
structured  
Supports  
against the

- JC3IEDM documentation in structured format (annotations)
- Supports consistency checks against the UML PIM

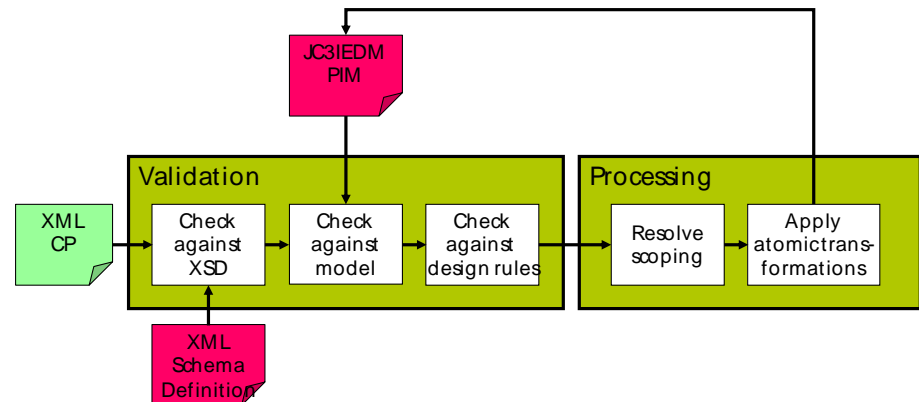
# Improved Change Management

Problem:

- Change Proposals (CPs) are provided as semi-structured Word documents
- Approved CPs must be applied manually to the JC3IEDM by a core group of experts
- National/COI-specific extensions are inadequately tracked

Solution: Formal technical CPs

- Atomic operations (e.g., add new attribute, modify domain value)
- Meta information inspired by NATO Discovery Metadata Specification (NDMS)
- CPs are tracked in the model itself
- ➔ Early validation of CPs
- ➔ Automatic processing of CPs



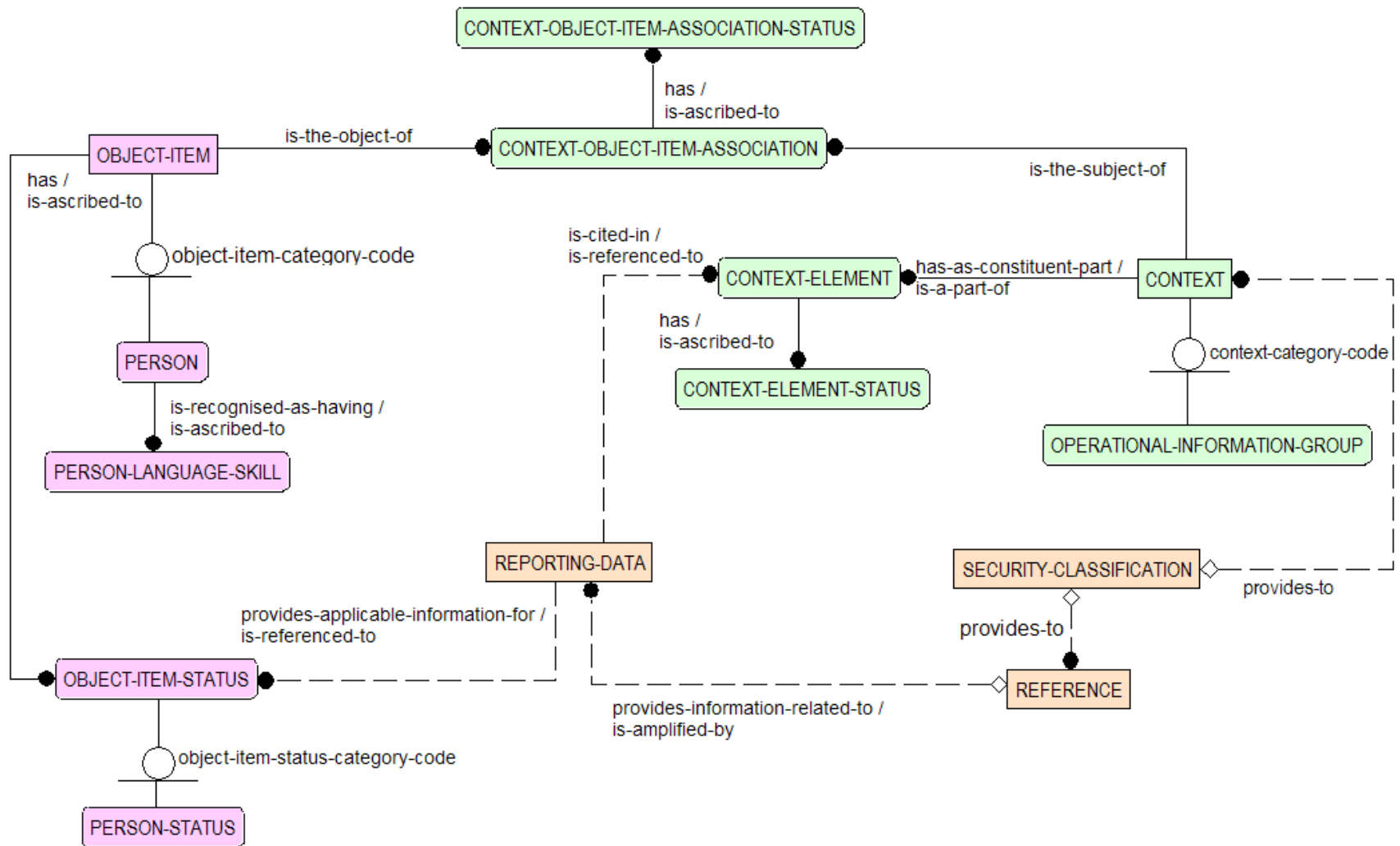
# PIM Restructuring



# Motivation

- Resolve well-known problems/workarounds, e.g.,
  - Deletion/update of information
  - Grouping of information
  - Archiving
- Make the model independent from a specific exchange mechanism
- Generalize existing concepts
- Provide a sound basis for the definition of capability-specific sub-models

# JC3IEDM 3.0.2 – Metadata & Information Groups



# Logical Layers in the Data Model

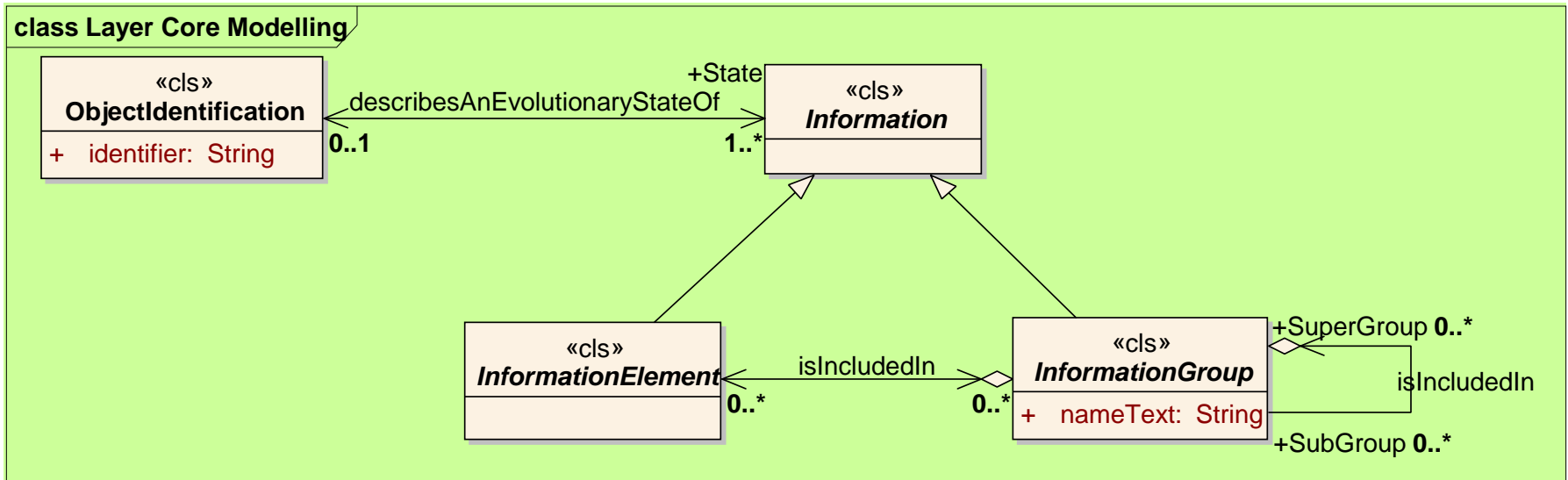
Core Modeling Layer  
(Information & Information Group Concepts)

Metadata Layer

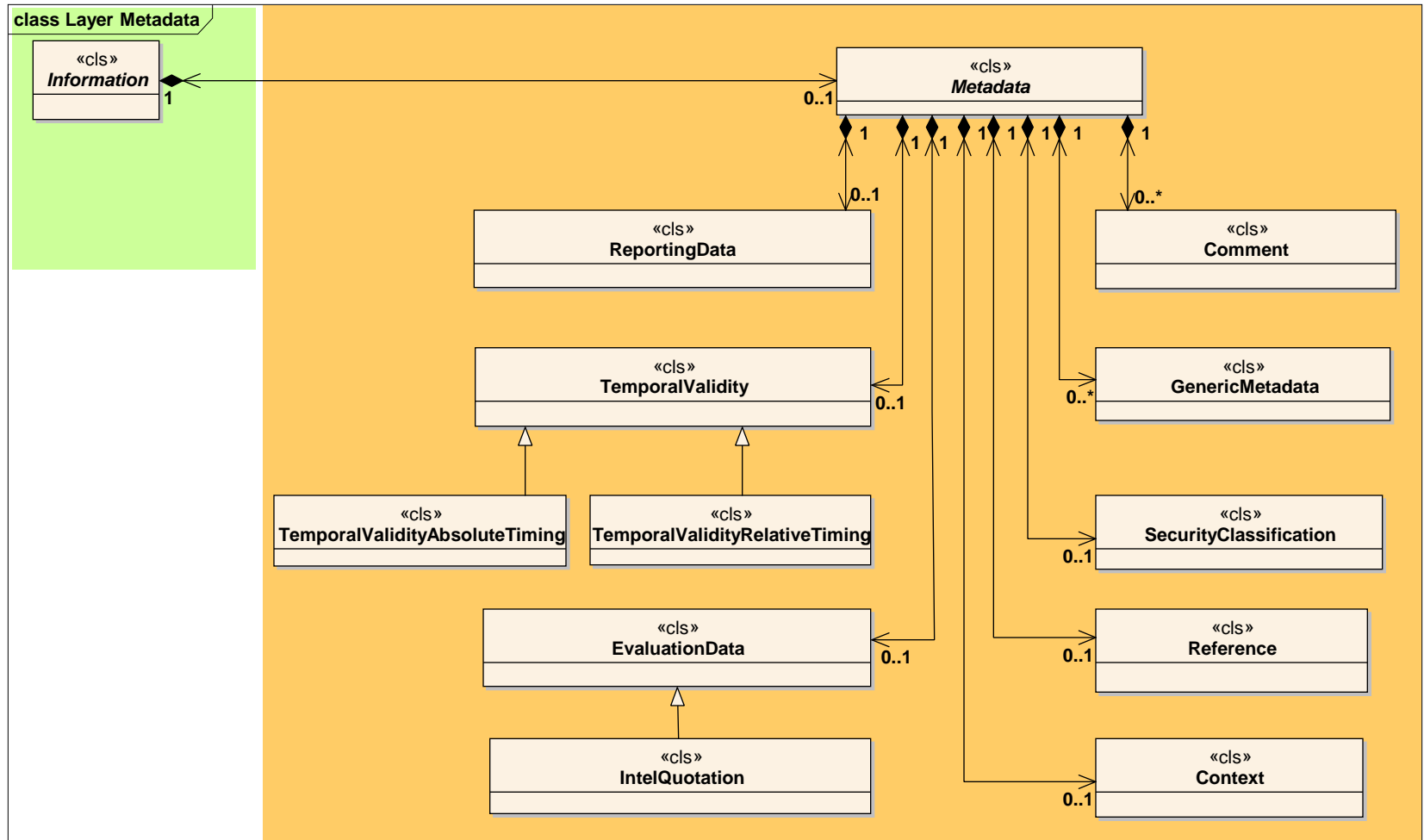
Staff Objects Layer  
(Grouping and Manipulating Objects)

Battlefield Objects Layer  
(Granular Objects)

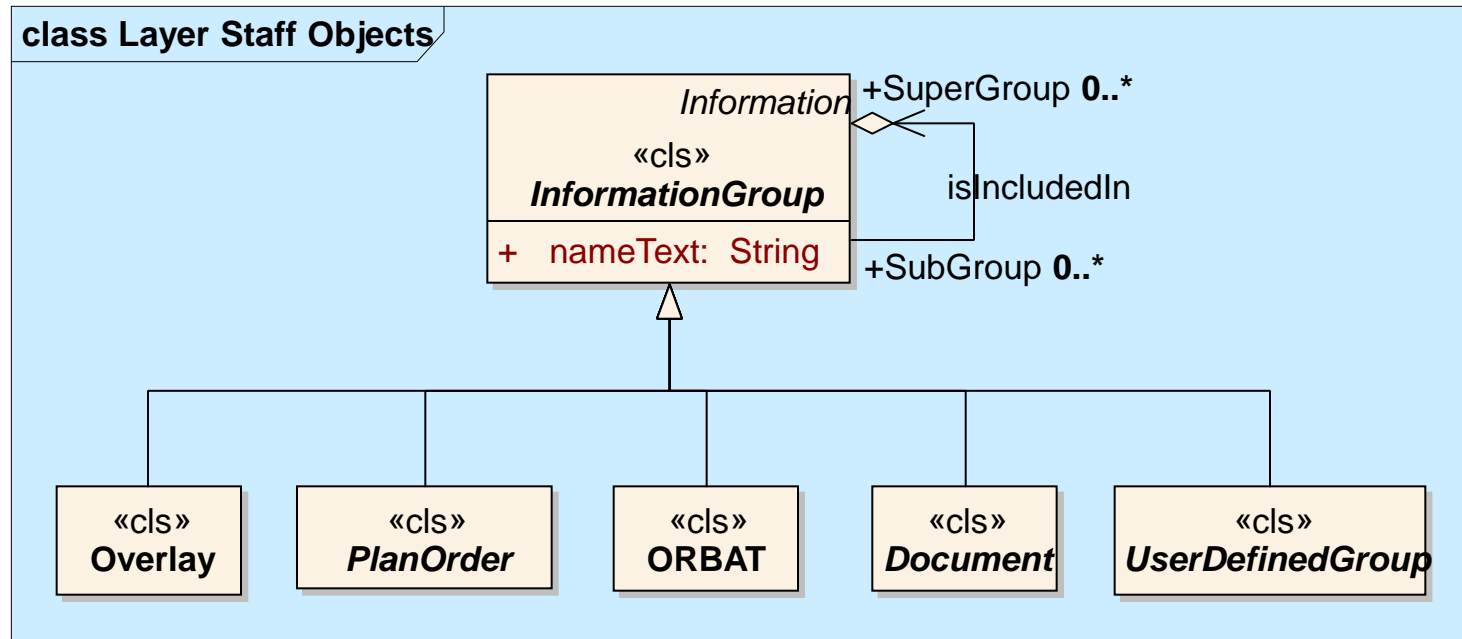
# Core Modelling Layer



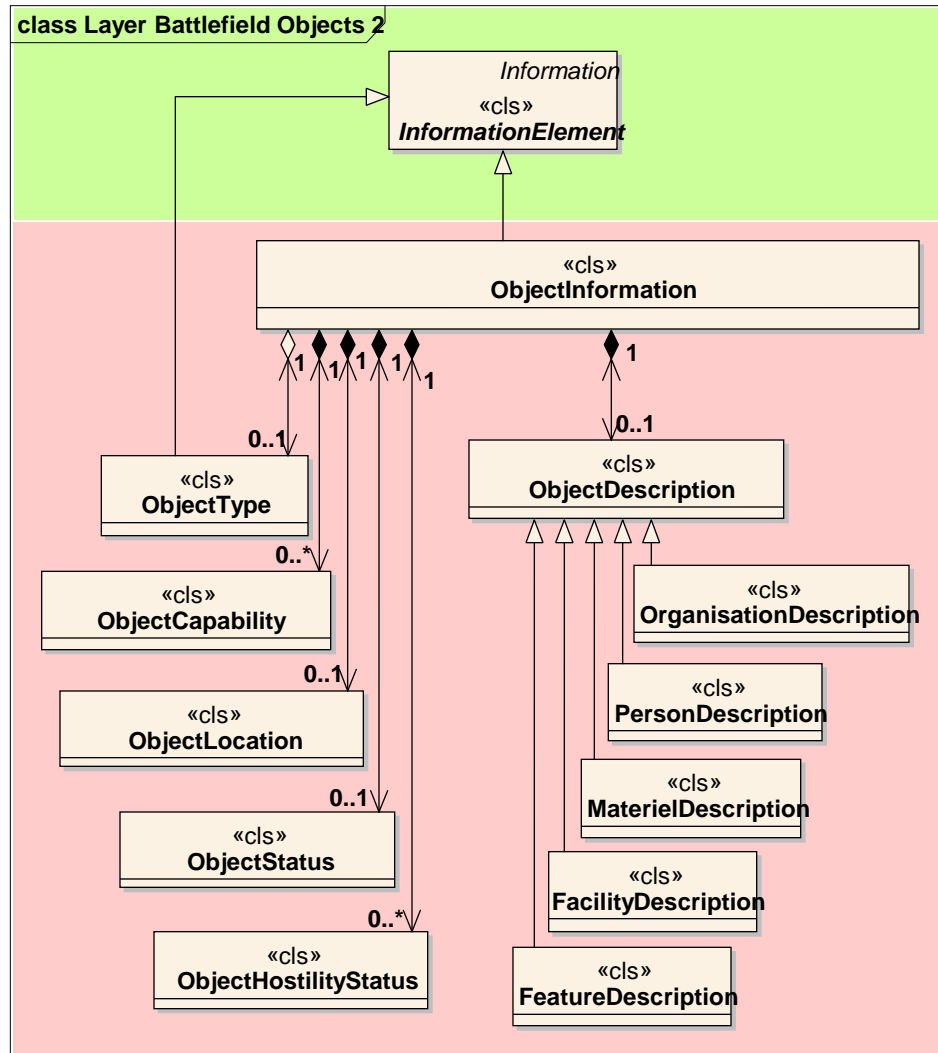
# Metadata Layer



# Staff Objects Layer



# Battlefield Objects Layer



- Only *ObjectInformation* are linked to an information group
- Value objects such as *Location* and *Status* are linked implicitly
- *ReportingData* is no longer abused for grouping

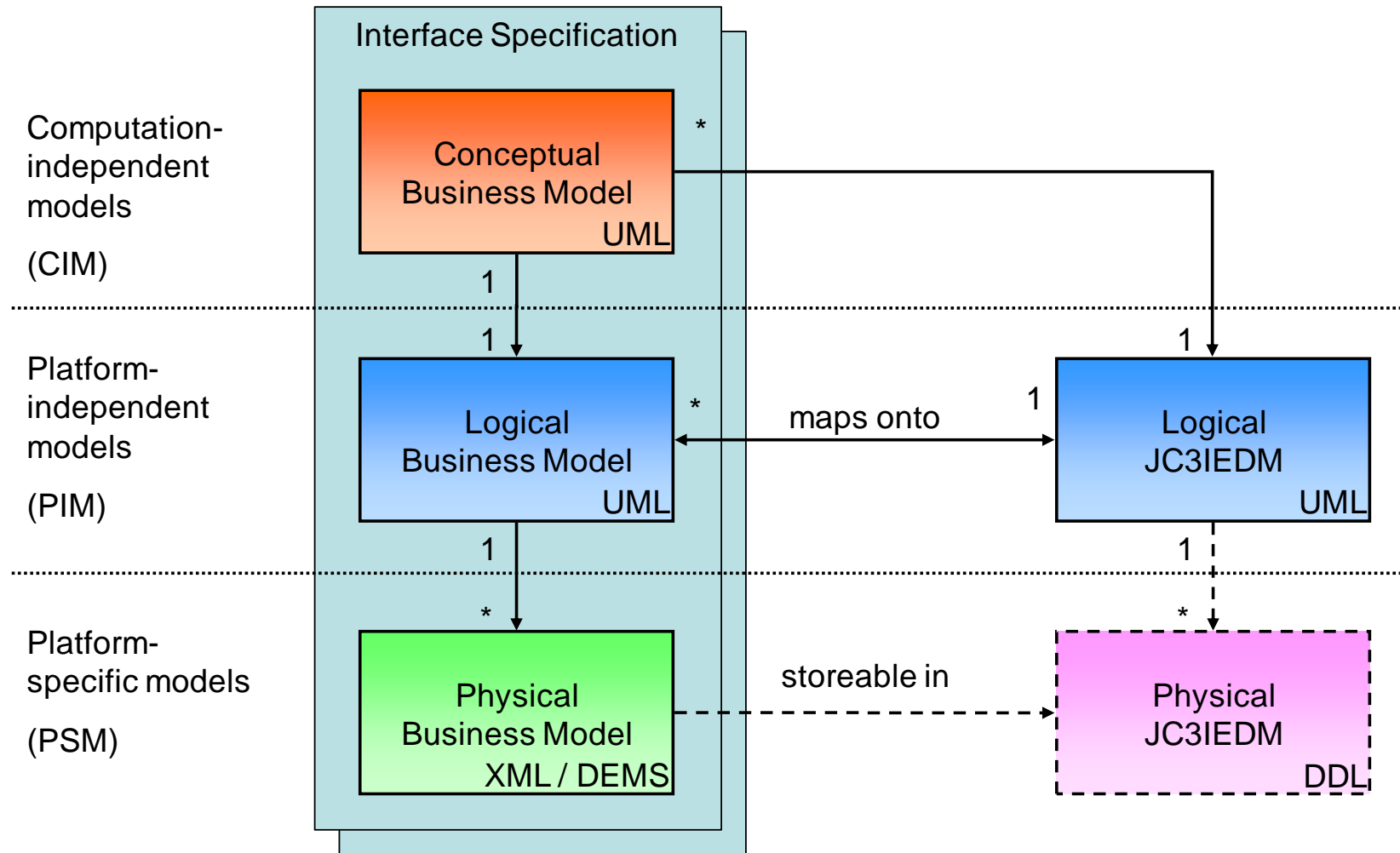
# Modularization



# Motivation

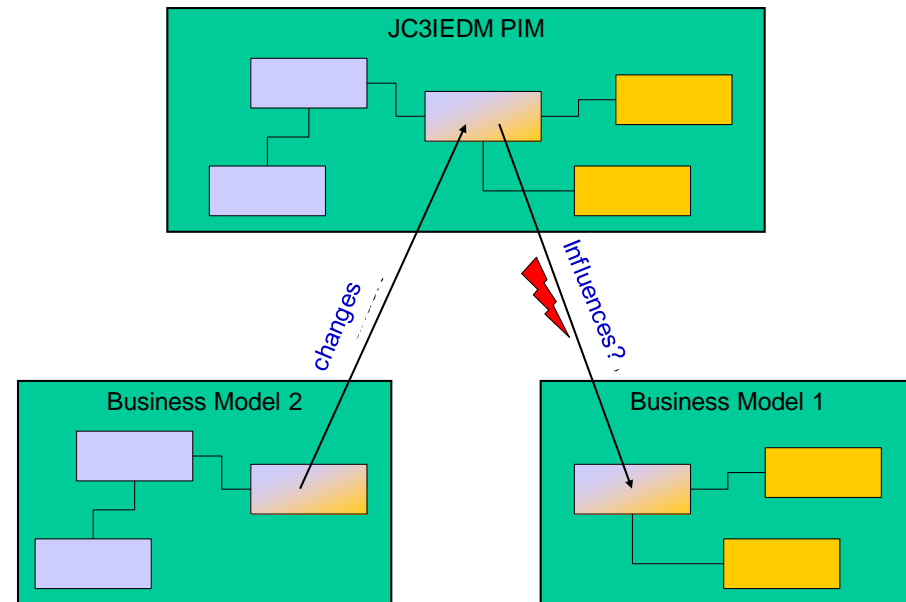
- Faster response to user requirements
  - From operational requirement to the field
- Keep existing information exchange services stable
  
- ➔ Incremental delivery of independent capabilities
- ➔ Modular interoperability solution
  
- Complete specification of information exchange capabilities
  - Data modeling is considered part of the overall modeling process!
  - NATO Architecture Framework
    - Operational Views
    - Service Views
    - System View

# Business Models



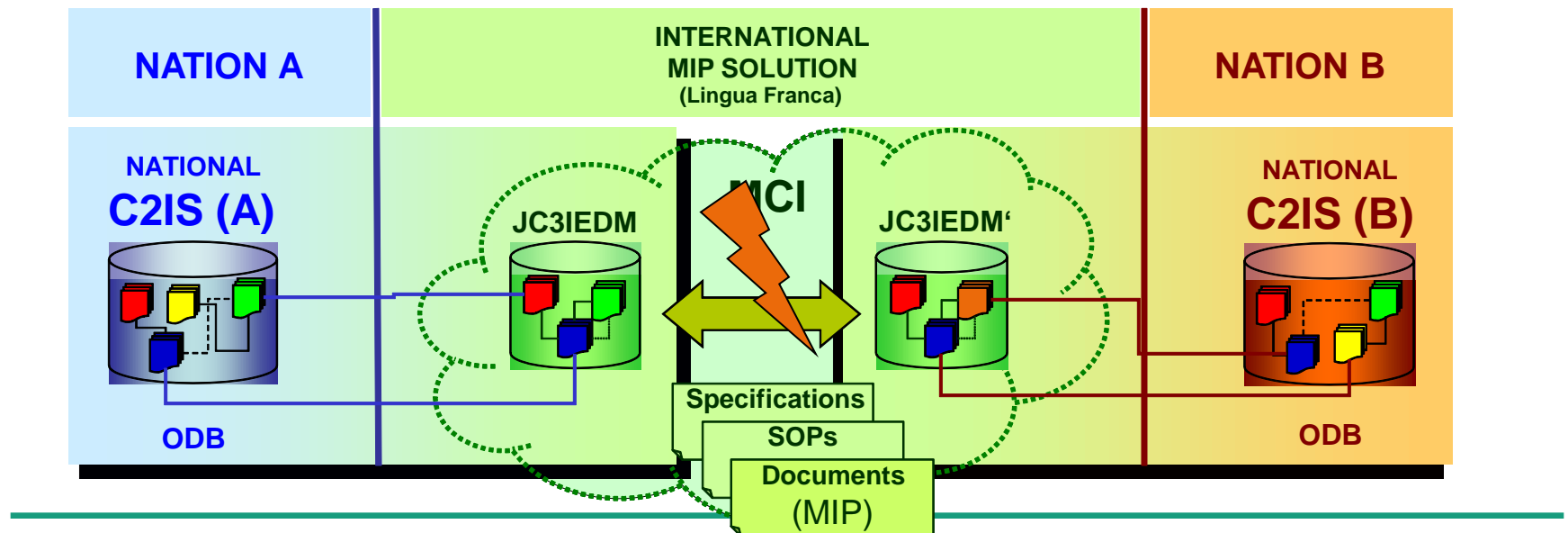
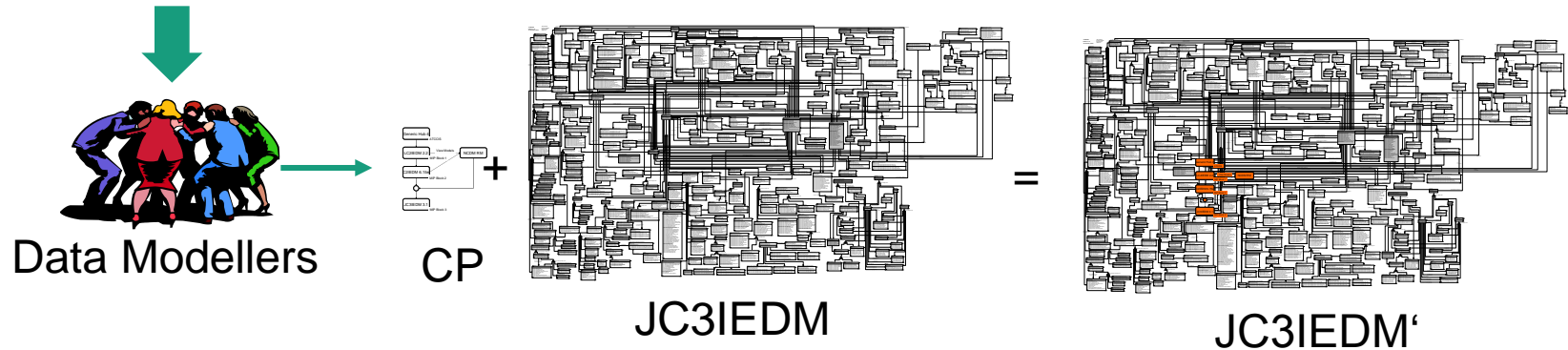
# Data Management Challenges

- New business models may require extensions/changes to the JC3IEDM
- Changes to the JC3IEDM may have impact on existing business models
- ➔ Need for impact analysis (configuration management, versioning, ...)
- Proposed solution: Define business models by transformation scripts



# Interoperability Based on Monolithic Model

Operational Requirement  
/ Feedback

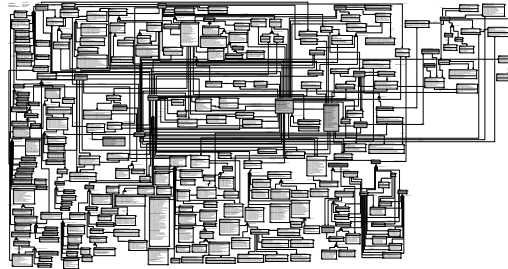


# Interoperability Based on Business Models

Operational Requirement  
/ Feedback

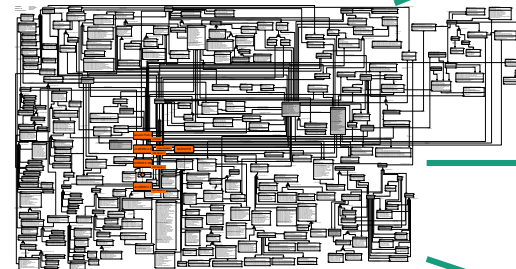


Data Modellers CP



JC3IEDM

=



JC3IEDM'

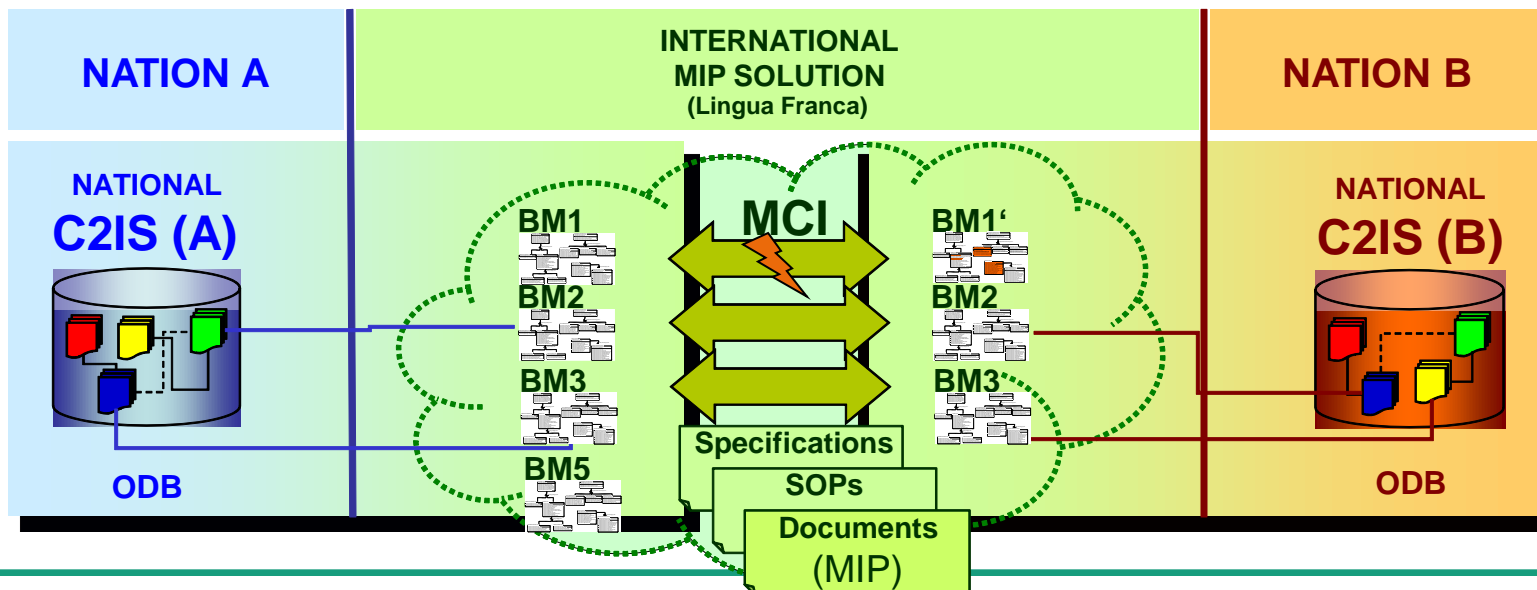
BM1'



BM2



BM3



# Summary

# Summary (1)

- Improved configuration management
  - UML platform-independent model of the JC3IEDM 3.0.2
    - Available in Sparx Enterprise Architect format
    - Semantically equivalent to ER model
  - PSM generators available for XSD, OWL, SQL, Java
  - CPPProcessor for automatic processing of change proposals
  - Unofficial web site: <http://mda.cloudexp.com/>
- PIM Restructuring
  - Concept proposal addresses issues, constraints, and workarounds
  - Semantics of the JC3IEDM operational concepts is basically maintained
  - Technical CPs currently under development

# Summary (2)

## ■ Modularization

- Supports incremental delivery of new capabilities/services
  - Smaller, but clearer specified capabilities
- Data modelling is not an isolated task
  - Clear traceability to individual capabilities/services
  - No data modelling for the sake of it!
- JC3IEDM is used as a semantic reference

## ■ Potential collaboration between MIP and C-BML community

- Provide feedback on operational & structural aspects
- Identify relevant subview of the JC3IEDM
- Harmonization of IERs by NATO APP-15?



***Thank you  
for your attention!***